

## CLAIMS

What is claimed is:

1. An integrated heat sink fuel cell assembly comprising:
  - 5 a. a heat sink assembly comprising a base and at least one cooling fin extending from the base;
  - b. at least one connector extending from the heat sink assembly to a heat source; and
  - c. at least one fuel cell comprising a cathode and an anode integrally disposed within the cooling fin and between the cathode and the anode is an electrolyte.
- 10 2. The integrated heat sink fuel cell assembly of claim 1, wherein the heat sink assembly with the cooling fin is positioned to interact with air to dissipate heat.
3. The integrated heat sink fuel cell assembly of claim 2, wherein the cathode is disposed within the cooling fin to interact with the air.
4. The integrated heat sink fuel cell assembly of claim 1, further comprising an active air  
15 moving device connected to the heat sink assembly for increasing air flow over the cooling fin and cathode.
5. The integrated heat sink fuel cell assembly of claim 1, wherein the active air moving device is selected from the group: a fan and a heat pump.
6. The integrated heat sink fuel cell assembly of claim 1, wherein the fuel cell further  
20 comprises:
  - a. a plurality of cooling fins connected to the base with at least one fuel cell in each cooling fin, wherein each fuel cell in each fin comprises an anode and a cathode separated by a channel and electrolyte is disposed in the channel; and

- b. a fuel plenum is in communication with the anode and within the heat sink assembly, and an oxygen source is in communication with the cathode.
- 7. The integrated heat sink fuel cell assembly of claim 1, wherein the cathode is mechanically secured to the cooling fin with a bolt.
- 5 8. The integrated heat sink fuel cell assembly of claim 1, wherein the electrolyte is contained in a membrane assembly.
- 9. A method for making an integrated heat sink fuel cell assembly comprising the steps of:
  - a. providing a heat sink assembly having a base and a cooling fin extending from the base;
  - 10 b. creating a channel having a first wall and a second wall in the cooling fin;
  - c. forming an anode in the first wall and a cathode in the second wall using a catalyst;
  - d. connecting the anode to a fuel plenum and the cathode to an oxygen source; and
  - e. disposing an electrolyte in the channel between the anode and the cathode.
- 15 10. The method of claim 9, further comprising the step of forming the anode and the cathode in the first and second walls by embedding catalyst in the first and second walls.
- 11. The method of claim 9, wherein the channel is created using a method selected from the group consisting of etching, embossing, laser cutting, water jet cutting, micro molding, LIGA processing, deep reactive ion etching, electro discharge machining, powder  
20 packing, and combinations thereof.
- 12. A method for making an integrated heat sink fuel cell assembly comprising the steps of:
  - a. providing a heat sink assembly having a base having at least one cooling fin comprising a first side and a second side wherein the fin extends from the base;
  - b. forming an anode on the first side;

- c. attaching a membrane assembly having a top and a bottom to the anode, wherein the bottom of the membrane assembly attaches to the anode;
  - d. attaching a cathode to the top; and
  - e. connecting the anode to a fuel plenum and the cathode to an oxygen source.
- 5 13. The method of claim 12, wherein the membrane assembly comprises a membrane comprising:
  - a. a first seal;
  - b. a second seal;
  - c. a first gas diffusion electrode;
  - 10 d. a second gas diffusion electrode; and
  - e. an electrolyte.
- 14. A heat sink assembly for a heat source comprising:
  - a. a heat sink adapted for contacting the device, having a base and at least one cooling fin extending upwardly from the base;
  - 15 b. at least one connector extending from the heat sink assembly to the heat source; and
  - c. at least one fuel cell comprising a cathode and an anode integrally disposed within the cooling fin, wherein the fuel cell comprises: an anode, a cathode and an electrolyte.
- 20 15. The heat sink assembly of claim 14, wherein the heat source is selected from the group consisting of an electronic device, a motor, a transformer, and a solenoid.

16. The heat sink assembly of claim 14, wherein the device is selected from the group consisting of an electronic device, a motor, a transformer, and other heat generating devices.